APPENDIX D

Legacy Support

This appendix summarizes assignments for interrupt request (IRQ), direct memory access (DMA), and I/O port addresses used by built-in devices on legacy system boards. This appendix also includes requirements for any Industry Standard Architecture (ISA) legacy implementations.

Contents

Fixed ISA Interrupts

The following IRQs are used by ISA devices and are considered to be fixed assignments.

Fixed ISA Interrupts

Hardware IRQ	Default assignment
IRQ 0	System timer
IRQ 1	Keyboard
IRQ 2	Second programmable interrupt controller (PIC) cascade
IRQ 3	COM 2
IRQ 4	COM 1
IRQ 5	Sometimes LPT 2—not considered fixed
IRQ 6	Standard floppy disk controller (FDC)
IRQ 7	LPT 1
IRQ 8	Real-time clock/CMOS
IRQ 9	—
IRQ 10	Sometimes COM 4—not considered fixed
IRQ 11	Sometimes COM 3—not considered fixed
IRQ 12	PS/2-style mouse
IRQ 13	Coprocessor
IRQ 14	Primary Integrated Device Electronics (IDE) controller
IRQ 15	Secondary IDE controller

Legacy ISA DMA Assignments

The following table lists DMA channel assignments that are used by legacy ISA devices and are therefore considered fixed.

Legacy ISA DMA Considered Fixed

Hardware DMA	System function (default)
DMA 0	ISA expansion
DMA 1	—
DMA 2	FDC
DMA 3	extended capabilities port (ECP) parallel port on LPT 1
DMA 4	DMA controller cascading
DMA 5	—
DMA 6	—
DMA 7	—

Legacy ISA I/O Address Assignments

The following table lists I/O addresses that are used by legacy ISA devices and are therefore considered fixed.

Legacy ISA System I/O

I/O Address	Default system function
0000–000F	Slave DMA
0010–0018	System
0001F	System
0020–0021	Master 8259
0040–0043, 0048–004B	Programmable interrupt timer (PIT) #1, PIT #2
0050–0052	System
0060	Keyboard/mouse controller
0061	System control port B
0064	Keyboard/mouse status
0070–0071	Nonmaskable Interrupt (NMI) enable/real-time clock
0081–008B	DMA page registers
0090–0091	System
0092	System control port A
0093–009F	System

Continued

Legacy ISA System I/O *(continued)*

I/O Address	Default system function
00A0–00A1	Slave interrupt controller
00C0–00DE	Master DMA controller
00F0–00F1	Coprocessor busy clear/reset
0170–0177	Secondary IDE controller
01F0–01F7	Primary IDE controller
0201	Joystick interface
0220–022F	Sound Blaster
0278–027A	LPT 2 (XT parallel port 3)
02E8–02EF	Alternate COM (4)
02F8–02FF	COM 2
0330–0331	MPU-401
0376	IDE Controller
0378–037A	LPT 1 (XT parallel port 2)
0388–038B	Frequency modulation (FM) synthesis
03B0–03BB	MDA, EGA/video graphics array (VGA)
03BC–03BE	LPT 3 (XT parallel port 1)
03C0–03DF	EGA/VGA
03E0–03E7	PCIC PCMCIA controllers
03E8–03EF	Alternate COM (3)
03F0–03F7	FDC — excluding 03F6
03F8–03FF	COM 1
0534–0537	Windows Sound System-compatible
0CF8–0CFB	Peripheral Component Interconnect (PCI) ports

Plug and Play ISA System Requirements

Although in general ISA devices are excluded from PC 99, many PC 99 systems will include ISA support that allows users to insert ISA add-on devices. This section summarizes the basic requirements for a PC system that includes the ISA bus. In PC 97, ISA was required to be implemented with full support for Plug and Play ISA boot devices.

In addition to ISA expansion cards, the following are also ISA devices:

- 8042 and similar controllers, ports, keyboards, and mice
- DMA controllers and slaves
- FDCs
- Interrupt controllers
- Legacy parallel and serial ports
- Math coprocessors
- PITs
- VGA controllers

Any such devices located at I/O addresses below 100h can use fixed resources and are exempt from Plug and Play requirements for unique IDs, flexible resource configuration, and dynamic disable capabilities.

1. System supports Plug and Play ISA specification and Plug and Play BIOS
Required

If ISA support is included in a PC 99 system, the manufacturer must implement the standards described in the following Plug and Play specifications:

- *Plug and Play ISA Specification, Version 1.0a*
- *Plug and Play BIOS Specification, Version 1.0a*
- *Clarifications to the Plug and Play BIOS Specification, Version 1.0a.*

The Plug and Play specifications are available at http://www.microsoft.com/hwdev/specs/pnpspecs.htm. Additional ISA clarifications and white papers related to ISA Plug and Play under the Microsoft Windows operating system are available at http://www.microsoft.com/hwdev/busbios/.

Note: Standard system devices are excluded from this requirement. The system can reserve static resources for devices such as interrupt controllers 1 and 2, timer (8254-2), keyboard controller (8042), real-time clock, DMA page registers, DMA controllers 1 and 2, and math coprocessor (if present). For a system based on Intel Architecture, these fixed resources are located at I/O addresses below 100H and can also include an NMI mask.

Plug and Play ISA Device Requirements

This section includes additional requirements for ISA cards, including requirements for design implementations that appear only as recommendations in the ISA specification, to ensure that such cards will perform correctly under Windows.

The information in this section is provided for manufacturers of ISA devices who want to ensure that their devices are completely compatible with Plug and Play operating systems.

For more details, see the Plug and Play ISA specification.

2. ISA device complies with Plug and Play ISA standards
Required

Any card or bus that implements Plug and Play ISA must fully implement the standards defined in the *Plug and Play ISA Specification, Version 1.0a.* This specification also defines the requirements for a unique ID for each ISA device. The unique ID is used to identify the device for Plug and Play configuration.

3. Option ROMs are used only on cards with boot devices
Required

This requirement applies only for x86-based systems. Option ROMs must be used only on cards that contain boot devices.

Cards with option ROMs must not hook the primary boot interrupts (Int 9h, Int 10h, Int 13h, Int 18h, and Int 19h) until the system calls the boot connection vector in the selected option ROM expansion header.

For cards with option ROMs, the default configuration must be able to be disabled after the card has been isolated.

4. Implement full 16-bit I/O address decode logic
Required

This circuit can be simple enough to limit I/O addresses to the 0h to 3FFh range, or it can be flexible enough to use the upper address regions. For more information, see Chapter 3, “PC 99 Basic Requirements.”

5. ISA device and driver support IRQ sharing if resource requirements cannot be met

Required

This requirement does not apply for Windows NT drivers. This is a requirement only if the device cannot meet the PC 97 resource requirements (as defined for the particular device class in the related chapter in Part 4 of *PC 97 Hardware Design Guide*). This requirement applies only for devices of the same class, not across device classes.

To share IRQs, the following requirements must be met:

- The IRQ line must be pulled high by the system board.
- The IRQ line must never be driven high by the devices.
- To signal an interrupt, devices must pull the IRQ line low for a minimum of 100 nanoseconds and then release it. The interrupt is signaled by the rising edge that occurs as a result of the pull-up on the IRQ line.
- The drivers for all devices connected to the IRQ line must correctly support the interrupt-sharing services of the virtual programmable interrupt controller device (VpicD). This means that after dispatching an interrupt from VpicD, the drivers must respond to VpicD and correctly indicate whether they actually processed an interrupt for their devices. VpicD will ensure that all devices with pending interrupts have been serviced before returning from the interrupt.
- IRQ sharing support implemented in the device driver for servicing interrupts.

6. Unimplemented registers return a deterministic value when read

Required

Any unimplemented registers in the range 00h–2Fh must return a deterministic value when they are read. Unimplemented configuration registers must return the “disabled” or “unused” value (not necessarily 0) when they are read.

7. Each ISA card provides complete and correct identifiers

Required

In the Plug and Play ISA specification, it is required that a Plug and Play card have both an industry-unique Vendor ID (acquired by sending e-mail to pnpid@microsoft.com) and a company-unique Product ID (assigned by the manufacturer). The specification requires that this Product ID be unique among all Plug and Play ISA cards manufactured by that company. This means each product (for example, fax card, display adapter, sound adapter, and so on) and every model (for example, 14.4 fax, 28.8 fax, and so on) from the same manufacturer must have different product identifiers.

This is a requirement because it allows the operating system to isolate and identify these different cards. The user must never have a Plug and Play card that cannot be identified because it cannot be distinguished from other models of cards from the same manufacturer. The use of a unique Product ID does not solve the problems that occur when a user installs two of the same cards in a PC system.

In those cases, the user might install a Plug and Play card but will not receive indication that it was installed and the card will not work. For this purpose, the Plug and Play ISA specification defines a unique serial-number field that can be added to the Vendor and Product IDs to make the card completely unique. A board-unique number in the serial-number field is required for ISA devices included on a system.

8. ISA system board devices are reported through the BIOS or use unique Serial ID

Required

A peripheral ISA device implemented on the system board can use a fixed Serial ID (which is not unique) if the device is reported through the BIOS.

If the system board device participates in the Plug and Play ISA isolation scheme (rather than being reported through the BIOS), then it must meet the same requirements for a unique Serial ID as for an add-on card.

Notice that it is possible that an add-on card containing an ISA chip might be added to a PC system that contains the same chip on the system board. In such a case, the add-on device will be found only if it has a different Serial ID.

9. IDs using PNP suffix are allowed only in the Compatible Device ID field

Required

Device IDs that use the three-character PNP suffix are allowed only in the Compatible Device ID field and cannot be used as Device ID or Logical Device ID fields. The exception would be the device to which the PNP-based ID was originally assigned.

Resource data describe what resources must be available for each logical device on the card (for example, number of available IRQ numbers, address ranges of memory, and so on). Resource data can be stored in the same nonvolatile storage device (such as a serial ROM) that contains the serial identifier. The resource data in the nonvolatile storage device must be sequentially loaded into the resource data register (04h).

The content of the nonvolatile storage device must be programmed with the information the system needs to interpret which resources the card requires. The structure of the data contained in the storage device is variable, depending on what resources are needed.

The resource data for a Plug and Play ISA card can be read while the card is in the Config state. This card can enter the Config state either after it has been isolated during the isolation sequence or whenever it receives a Wake (Card Select Number [CSN]) software command in which the CSN matches the CSN assigned to the card. Only one card at a time can be in the Config state.

10. Option ROMs correctly support boot devices

Required

Plug and Play ISA expansion cards that contain boot devices require some special considerations to properly boot the system. For PC 97, the system must implement support for Plug and Play ISA boot devices and option ROMs as described in the Plug and Play BIOS specification.

The types of devices required for the boot process include the primary input device (usually a keyboard), the primary output device (usually a display adapter and monitor), and any Initial Program Load (IPL) devices.

Any Plug and Play ISA expansion card that provides a boot function must be active when the system powers up. This gives non-Plug and Play systems the means for using Plug and Play ISA devices during a legacy boot process. In this case, a non-Plug and Play system BIOS will not perform the isolation sequence but will instead perform a ROM scan to detect the presence of a boot device. After the ROM scan detects the presence of an option ROM on the boot device, the system ROM will jump to the option ROM to initialize the device. The Plug and Play option ROM on the card will detect that the system BIOS is not Plug and Play-compatible and will respond accordingly. Although an initial set of static resources must be provided during this legacy boot, the Plug and Play ISA card must be capable of changing these resources using the standard Plug and Play ISA isolation and configuration process.

As required in the Plug and Play ISA specification, resource usage of a card is always reflected in the card’s configuration registers. This information allows Windows 95 to easily determine the default settings of a Plug and Play boot device. The default settings can then be overridden by the operating system with full cooperation of the device driver.